REMARKS

Claims 1-27 are pending in the application. Claims 1, 2, 4-6, 8-10, 13, 15-18, and 21-25 are rejected. Claims 3, 7, 11, 12, 14, 19, 20, 26, and 27 are objected to.

In the Office Action, the Examiner rejected claims 1, 4-6, and 8 pursuant to 35 U.S.C. §103(a) as being unpatentable over Heimdal et al. (U.S. Patent No. 6,776,759) in view of Criton et al. (U.S. Patent No. 6,537,221), and further in view of Lazenby (U.S. Patent No. 5,855,557). Claim 2 stands rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Heimdal et al. in view of Criton et al. and Lazenby, and in further view of the background section. Claims 9-10, 13, and 15-18 stand rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Heimdal et al. in view of Criton et al. and Lazenby, and further in view of Torp et al. (U.S. Patent No. 6,676,599) and Sumi (U.S. 2004/0034304).

Claims 3, 7, 11-12, 14, 19-20 and 26-27 have been objected to as being allowable if rewritten in independent form. Independent claim 14 was again objected to as being dependent on a rejected base claim. Because claim 14 was originally filed as an independent claim, claim 14 should have been allowed. Claims 21-25 were allowed on page 7 of the Office Action, but indicated as rejected on page 1. Applicants believe the Examiner intended to allow claims 21-25.

Applicants respectfully request reconsideration of the rejections of claims 1-2, 4-6, 8-10, 13, and 15-18, including independent claims 1, 13, and 15.

Independent claim 1 claims determining a spatial gradient vector in an acoustic domain and transforming the spatial gradient vector to a Cartesian coordinate system. Applicants respectfully submit that Heimdal et al. and Criton et al. do not disclose these limitations.

Heimdal et al. determine a one-dimensional strain rate (col. 8, lines 42-59). The strain rate is a real or complex value for a given location (col. 8, lines 51-59; col. 9, lines 42-48). The value is a magnitude. The strain rate is scan converted (col. 9, lines 23-39 and col. 10, lines 5-10). The complex strain rate maintains phase information, such as shift for determining Doppler velocity, (col. 6, lines 10-15), not necessarily direction information. The real or complex strain rate is used to determine a color for each location, not a direction (col. 9, lines 35-38 and col. 10, lines 7-10).

Criton et al. calculate strain along a direction of tissue movement (col. 12, lines 30-40). The vectoral component of motion is used to calculate the strain rate (col. 12, lines 34-40). The result, like Heimdal et al., is a strain rate value or magnitude, not a vector. While a vector along one or two dimensions may be used to determine the strain rate, only the strain rate, not the vector is scan converted. Thus neither Heimdal et al. nor Criton et al. disclose transforming a spatial gradient vector to a Cartesian coordinate system.

In response to the arguments above, the Examiner added Lazenby. Lazenby was added to show that in the context of motion studies, it was known to preserve the vector as well as the tensor information in the acoustic domain. However, Heimdal et al. and Criton et al. fail to disclose preserving the vector information in the display or Cartesian coordinate domain. Both are concerned with calculating a scalar value, strain rate. While Lazenby shows at least scan conversion of a one dimensional velocity vector, Lazenby is directed to displaying divergence and rotation of the velocity vector field (col. 1, line 61 - col. 2, line 4). Based on the strain rate disclosures of Heimdal et al. and Criton et al., Applicants respectfully submit that there is no reason to scan convert the spatial gradient vector even given the disclosures of Lazenby. Because Heimdal and Criton et al. desire to display strain rate or magnitude information, a person of ordinary skill in the art would not have used the scan conversion of a velocity vector of Lazenby with the strain rate of Heimdal et al. and Criton et al.

Dependent claims 2-12 and 26-27 depend from independent base claim 1, and are thus allowable for at least the same reasons discussed above. For example, claim 4 claims generating a two dimensional image from ultrasound data as a function of the transformed spatial gradient vector. Heimdal et al. and Criton et al. do not transform a vector, and thus do not generate an image as a function of a transformed vector. Similarly, there is no suggestion to generate an image from data as a function of the vector where the vector is calculated from the same data.

As another example, claim 5 claims filtering ultrasound data as a function of the transformed vector. Heimdal et al. and Criton et al. do not transform a vector, so do not filter as a function of the transformed spatial gradient vector. Heimdal et al. filter the strain rate, but do not suggest the filtering of data as a function of a vector.

As yet another example, claim 9 claims calculating spatial derivatives in the Cartesian coordinate system as a function of multiplication of spatial gradient vectors in the acoustic

domain by a matrix. Torp et al. and Sumi are relied on for this limitation. Torp et al. use matrix multiplication to determine strain rate along a direction of tissue movement (col. 13, lines 37-67). The data is determined relative to tissue (UVW) from data in an acoustic domain (XYZ) (col. 13, lines 40-46 and col. 13, line 65 - col. 14, line 40). Torp et al. do not suggest conversion to a Cartesian coordinate system using matrix multiplication. The cited portion of Sumi shows measuring displacement from data in a Cartesian coordinate format (¶ [00256]). Sumi processes already scan converted data, not conversion of the data. According to Heimdal et al. and Criton et al., scan converters are used, not matrix multiplication.

Claim 10 is allowable for at least the same reasons discussed above for claim 9.

Independent claim 13 claims calculating a spatial gradient vector representing a gradient in a Cartesian coordinate space from ultrasound data in an acoustic domain and free of scan conversion. Torp et al. show converting velocities in an acoustic domain to strain rates in a tissue domain (cols. 13 and 14). There is no suggestion to calculate a spatial gradient vector representing a gradient in a Cartesian coordinate space. Torp et al. calculate gradients in the acoustic space (col. 13, line 67 - col. 14, line 5) and convert the gradient, and thus do not suggest calculating a vector representing a gradient in the Cartesian coordinate space from data in acoustic domain.

Sumi use data in a Cartesian format at the cited section (¶ [00256]). The use of Sumi to show 2D or 3D strain does not suggest the calculation of a vector representing a gradient in Cartesian coordinate space from data in an acoustic domain. Applicants respectfully submit that none of the references show calculating a vector representing a gradient in Cartesian space from data in acoustic space.

Independent claim 15 claims resampling in an acoustic domain to ray-lines representing a viewing angle and determining gradient information from the resampled data. Torp et al. estimate strain rate in any direction (col. 5, lines 57-61). The strain rate for a given sample is based on tissue velocity from a small region around the sample (col. 5, lines 57-61). Because the tissue movement direction may vary throughout an image at a given time, Torp et al. desire strain rate based on local directional information. Torp et al. do not disclose resampling to ray-lines representing a viewing direction. Sumi processes in the Cartesian domain, not in the acoustic

domain at ¶ [00256]. Applicants submit that a person of ordinary skill would not have resampled to ray-lines representing a viewing angle because Torp et al. desire a locational or tissue region approach.

Dependent claims 16-20 depend from independent base claim 15, and are thus allowable for at least the same reasons. Heimdal et al., Criton et al., Lazenby, Torp et al., and Sumi, alone or in combination, fail to disclose limitations of the dependent claims. For example, claim 16 claims determining values along the ray-lines as a function of the resampled data and gradient information, and blending the values. Torp et al. determine the values by resampling or angle correcting, and thus do not determine values with the resampled data and gradient information.

CONCLUSION

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof. If for any reason, the Examiner is unable to allow the application but believes that an interview would be helpful to resolve any issues, he is respectfully requested to call the undersigned at (650) 943-7350 or Craig Summerfield at (312) 321-4726.

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